

WHAT IS CLAIMED IS:

1. A trackball control device comprising a housing, two coding shafts pivotally mounted on said housing about perpendicular axes, a trackball rotatably mounted in the housing and engaged with said shafts to pivot them, and two control signal generators, wherein each of said control signal generators comprises:

5 a pair of pinions, each having multiple teeth and each coupled to one of said coding shafts to rotate as the corresponding coding shafts rotates;

10 a pair of deflectable members that each has a first member part lying between a pair of teeth of a corresponding one of said pinions and biased toward a position between the pair of teeth, so the first member part is repeatedly deflected in first and second opposite directions, and released after each deflection, as the corresponding pinion turns in first and second opposite directions, respectively;

mean for generating electrical signals in response to deflection of each of said deflectable members.

2. The control device described in claim 1 wherein:

each of said deflectable members is electrically conductive and has a second member part that moves in primary and secondary directions when the first member part is deflected in said first and second directions;

5 said means for generating electrical signals for each deflectable member includes a first contact pad in constant electrical connection with the deflectable member, and a pair of second contact pads each positioned to be engaged by said second member part as it moves respectively in said primary and secondary directions.

3. The control device described in claim 1 wherein:

each of said deflectable members is a rod that has an upper end forming said first member part and that has a lower end, and each of said rods is pivotally

5 mounted about an axis lying between said rod upper and lower ends, wherein when the rod upper end moves in one direction the rod lower end moves in the opposite direction.

4. The control device described in claim 1 wherein:

5 at least a first of said deflectable members is part of a wire of a torsion spring, with one portion of the torsion spring locked against rotation and with a rod part of the spring forming said first deflectable member, said torsion spring biasing said rod part toward said position between a pair of teeth of a pinion.

5. The control device described in claim 4 wherein:

said rod part merges with an end turn of said torsion spring, and said rod part has a free end that moves, said means for generating electrical signals detects movement of said free end.

6. The control device described in claim 1 wherein:

said housing includes a housing main part and a cover that together form a housing cavity, said housing main part having a bottom wall with a primarily flat upper face;

5 a flat flex cable having a rear portion lying in said housing, with a majority of said rear portion lying facewise against said bottom wall, said flat flex cable rear portion having a plurality of exposed contact pads lying in said housing including at least one contact region electrically connected to each of said deflectable members, said flat flexible cable extending forwardly out of said housing.

7. The control device described in claim 6 wherein:

said housing main part bottom wall has a pair of upstanding projections, and said flat flex cable has a pair of tabs holding exposed contact pads each tab being bent at about a right angle from said majority of said cable rear portion and each tab

5       lying against one of said projections, so the tab can resist sideward forces pressing them toward the projections.

8. The control device described in claim 1 including:

a plurality of resilient biasing elements, each including a piece of sheet metal with a middle having about a 180° loop, one end pressing against the housing, and an opposite end pressing one of said shafts against said trackball.

9. The control device described in claim 1 wherein:

said axes of said coding shafts lie in a horizontal plane, and said trackball has a center lying below said plane.

10. A trackball control device comprising a housing, two coding shafts pivotally mounted on said housing about perpendicular axes, a trackball rotatably mounted in the housing and engaged with said shafts to pivot them, and two control signal generators, wherein a first of said control signal generators comprises:

5       a pinion having multiple teeth and coupled to a first of said coding shafts to rotate with the first coding shafts;

a metal wire forming a spring with a first end fixed to said housing and a second end having a proximal part biased toward a position between a pair of teeth of said pinion so said proximal part is deflected in right and left directions as said pinion turns in first and second directions, respectively;

10       said spring second end has a distal part that extends from said proximal part and that is moved in first and second directions as said proximal part moves in said right and left directions;

15       common, first and second electrical terminals, said common terminal being continuously connected to said spring and said first and second terminals lie in the path of said distal part to contact said distal part when it moves in said first and second directions.

11. The control device described in claim 10 including a second electronic device that is controlled by control signals generated by said signal generators, wherein:

5       said housing has a bottom wall with a flat surface and a slit leading from outside the housing to said flat surface;

      a flexible flat cable connecting said control signal generators to said second electronic device, said cable extending through said slit and having a cable in-housing portion lying on said bottom wall flat surface;

10       said cable in-housing portion having a plurality of exposed contact pads, and said signal generator has terminals directly engaged with a plurality of said contact pads.

12. A trackball control device comprising a housing, a pair of coding shafts pivotally mounted on the housing about perpendicular coplanar horizontal axes lying in a horizontal plane, a trackball that is spherical and that has a sphere center, said trackball being rotatably mounted in the housing and engaged with said shafts to pivot them, comprising:

5       a resiliently depressable dome element lying under said trackball, said dome element having a middle portion that biases said trackball upward;

10       said housing having a top with walls forming an opening through which a top of the trackball projects, said walls forming said opening maintaining said trackball at a height wherein said sphere center of the trackball lies below said horizontal plane.

13. The control device described in claim 12 wherein:

      said housing is molded of rigid plastic, but said walls forming an opening comprises a separate element formed of elastomeric material and having a lip with

a lip surface biased against the surface of the trackball.

5 14. A trackball control device comprising a housing, a pair of coding shafts pivotally mounted in the housing about perpendicular axes, a trackball rotatably mounted in the housing and engaged with said shafts to pivot them, and a pair of control signal generators coupled to said coding shafts that generate electrical signals indicating shaft rotations, said signal generators having terminals for carrying signals to a second electronic device, wherein:

said housing has a bottom wall with a largely flat surface and a slit leading from outside the housing to said flat surface;

10 a flexible flat cable connecting said control signal generators of said control device to said second electronic device, said cable extending through said slit and having a cable in-housing portion lying on said bottom wall flat surface;

said cable in-housing portion having a plurality of exposed contact pads, and said signal generator terminals are engaged with a plurality of said contact pads.

15 15. The control device described in claim 14 wherein:

said housing bottom wall is a molded plastic part that includes a plurality of upstanding projections, and said cable in-house portion has a plurality of bent upstanding tabs each containing an exposed contact pad and each lying against one of said lugs.

16. The control device described in claim 14 including:

a plurality of light emitting elements, each mounted directly on said cable in-house portion and spaced about a vertical axis of the trackball.

17. The control device described in claim 14 wherein:

a first of said signal generators includes a pinion fixed to one of said coding

5 shafts, a wire spring having a vertical wire with an upper end lying between a pair of teeth of the pinion and a lower wire end, said vertical wire being pivotal about an horizontal axis lying between said wire ends;

said cable in-house portion has a pair of bent upstanding tabs with contact pads lying on opposite sides of said wire lower end.

5 18. A trackball control device comprising a housing having an upper opening, a trackball pivotal about perpendicular axes in said housing and having an upper trackball end projecting up through said upper opening, a pair of coding shafts having ends pivotally mounted in said housing about perpendicular axes, each of said coding shafts engaged with said trackball to be pivoted by the trackball, and a pair of signal generators that generate electrical signals indicating pivoting of said coding shafts, wherein:

10 said housing includes a housing main part with bearing walls forming two sets of bearings for rotatably supporting said ends of said two coding shafts, and forming a recess adjacent to at least one bearing of each set;

a pair of resilient biasing elements, each lying in one of said recesses, each biasing element having a pair of arms connected by a largely 180° loop, one of said arms pressing against a wall of the recess and the other pressing against one of the ends of a coding shaft.

19. The control device described in claim 18 wherein:

said biasing elements are each formed of sheet metal and each has a width that is a plurality of times its thickness, to facilitate stable mounting of the biasing elements.